Simpson

INSTRUMENTS THAT STAY ACCURATE

HOW TO USE SIMPSON MODEL 479 AND 480 SIGNAL GENERATORS FOR UHF TELEVISION RECEIVER ALIGNMENT

SIMPSON ELECTRIC COMPANY

5200 West Kinzie St., Chicago 44, Illinois, EStebrook 9-1121

In Canada. Bach-Simpson, Ltd., London, Ontario

Price $1.00

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PREFACE

There has been considerable conjecture in the minds of television service men concerning the adaptability of servicing equipment for Ultra High Frequency receiver applications. The present day types of servicing instruments were developed and perfected for VHF applications, and were not intended for use at the much higher frequencies involved in UHF problems. However, there are many ways in which the present equipment can be adapted to the uses required for basic UHF alignment. It is the purpose of this book to describe how to adapt the equipment to these purposes. In the areas where UHF has already been introduced, the alignment difficulties experienced have shown that the adaptation of Simpson signal generators according to these instructions will definitely provide signals of the type, accuracy, and strength necessary to assist the service man in identifying the nature of troubles in their UHF circuits, and in correcting these troubles and aligning the receiver for satisfactory reception.

There are some UHF alignment problems which cannot be satisfied with this equipment. Most notable among these is too little signal strength in the output of the A.M. Generators to provide a usable marker above about 800 megacycles. However, this frequency is the lower limit of Channel 69, and there are very few station assignments which use these highest frequencies. So, for all the areas where the channels are below 68, this fact is still not a problem.

Eventually, there will be new signal generators on the market which will overcome these difficulties because their basic design will be engineered to the specific needs of Ultra High Frequencies. We at Simpson plan to have available, in the near future, a marker generator which may be used with the present Model 479 or 480 signal generator to provide markers throughout the entire range of UHF. Other future developments will better answer other requirements for all around servicing equipment for Ultra High Frequency receivers.

But your servicing problems exist now, and in the near future. So we will tell you how to use what you already have, or can get now, to help you work out your alignment problems until equipment designed for use in UHF is available.

Chicago, Illinois
March 16, 1953

Lloyd J. Austin
Sales Engineer
Simpson Electric Company

Figure 1. The Simpson Model 479 TV-FM Signal Generator.

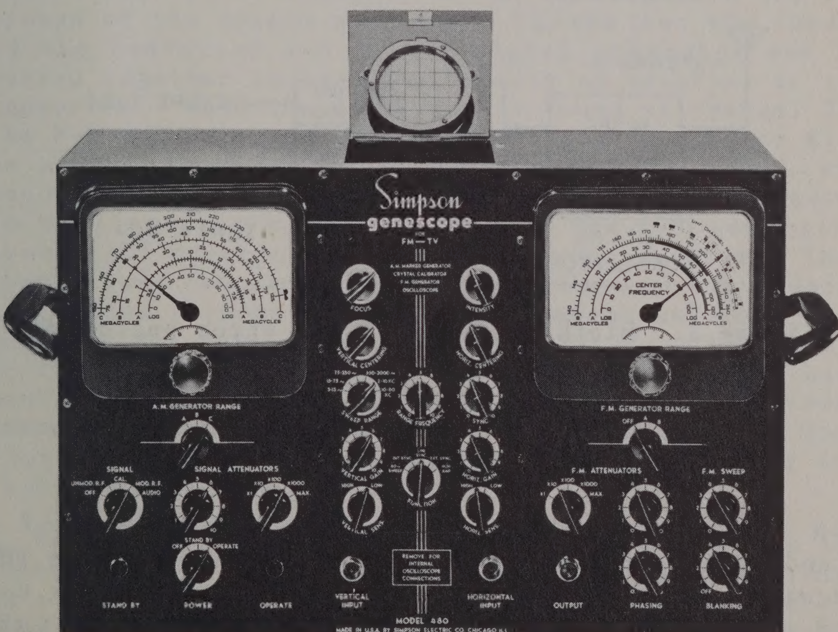

Figure 2. The Simpson Model 480 Genescope.

There are three general classes of circuit arrangements which are being used at the present time. In all probability, any new circuits developed in the future will be an adaptation of one of these present circuits. Figure 3 shows, in block diagram form, what each of these are.

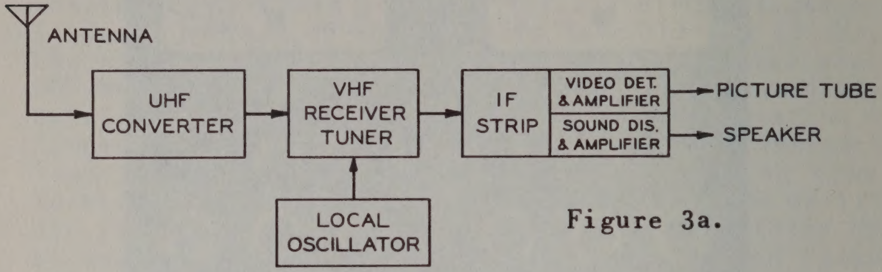

Figure 3a.

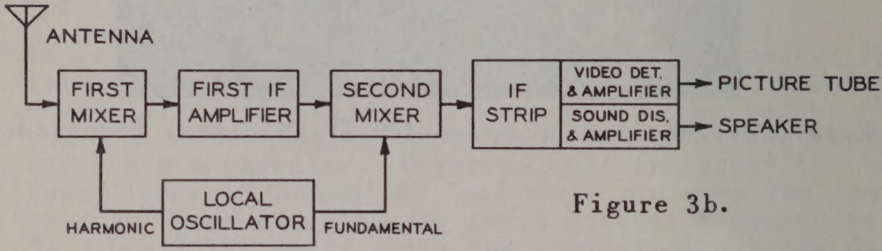

Figure 3b.

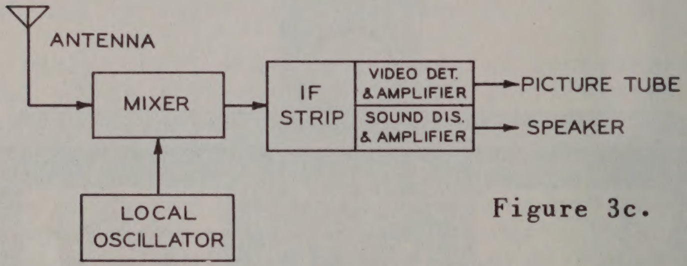

Figure 3c.

Figure 3. Block diagrams of the three basic UHF receiver types.
a. Converter plus VHF receiver.
b. UHF strip in turret tuner of VHF receiver.
c. Single conversion type receivers.

The arrangement which uses a converter ahead of a standard VHF receiver uses all the circuitry of the VHF receiver on a channel which was not previously in use and probably has never been critically adjusted at the

point of reception such as the channels which had previously been in use in the area. Usually channels 5 and 6 are the ones which may be used for UHF reception. Some brands of converters are set to produce an adjustable output on any channel from 7 through 13. At any rate, there will be at least one unused channel in the VHF input of the present television receiver which can now be designated for use as the UHF position of the tuner.

In order to obtain maximum signal response to the UHF transmissions, the intermediate frequency amplifier and sound sections of the VHF receiver must be adjusted for the best output available; then the VHF tuner must be correctly aligned at the VHF frequencies assigned to that channel; and finally, the output from the UHF converter is connected as the input to the VHF receiver terminals and the over-all ability of the entire receiver system is checked.

The necessary frequencies for the i-f system alignment and for the VHF r-f tuner alignment are all available as fundamental frequencies in the output of the Simpson Model 479 or 480.

The frequency settings of the two generators which will provide harmonics for the necessary UHF signals are available from the tables beginning on page 14 in this book. It is a simple matter to establish the response of the system at channel 14, and then the tuning of the converter and of the signal generator may be varied together to test the quality of tracking in the converter. When the converter is tuned at channel 21, the F-M generator section of the signal generator will be near the top of its range. Up to this point, the second harmonic of the generated signals has been used. To continue the tracking, retune the F-M generator around 173 megacycles for a new response curve. This should have the same shape as the response curve using the second harmonic of a higher fundamental, but will probably not have quite as much amplitude. This is due to the fact that each successive higher order of harmonics will have less strength than the lower order. Also, the waveform will have reduced in width. More frequencies are represented on the base line of the trace than were there before.

For any one setting of the F.M. Sweep control on the generator, the frequency deviation at a harmonic level is a harmonic of the width of frequencies swept at the fundamental. Both of these conditions can be corrected.

Either increased signal strength from the F-M generator or increased gain in the vertical amplifier of the oscilloscope will increase the height, while a decreased setting of the F.M. Sweep control of the generator will widen the response waveform on the trace. Tracking with the third harmonic of the F-M generator frequencies will tune the response up through channel 65. Then it is necessary to shift to the fourth harmonic, with another increase in the signal or gain and a decrease of the sweep control. The tuned point for fourth harmonic signal for channel 65 is at 195 megacycles. Now tracking can be continued through the end of the tuning range of the UHF converter. When the response waveform occurs with the F-M generator tuned at 222 megacycles, and the fourth harmonic is in use, the converter is tuned at the top of the frequency range for UHF - at channel 83!

The procedure of tracking for a continuous tuned converter is important for several reasons. First, it assures the service man that the range does actually extend through the necessary band of tunable frequencies, and second, that the characteristic response to the areas where local channels will be tuned are operating at maximum efficiency. Unfortunately, a tunable unit with the frequency coverage required of these UHF converters is difficult to build without having better response characteristics at some frequencies than at others. And these weak response points will vary between different units put out by the same manufacturer.

Do not condemn a particular brand of converters because one unit which you check does not respond in the particular channel area which you are to use for local reception. Chances are that the next unit which you check from the same company will have its strongest response at that desired channel. There is very little information available as yet to guide you in increasing the response at any point, but you should check to see that it is going to give satisfactory service before you install it for a customer.

Many manufacturers are requesting that units which are not tuned satisfactorily for your application be returned to their factory for service and alignment. Your job, then, is to identify whether or not the response is satisfactory, and then to act accordingly.

The second type of receiver design is the VHF receiver with a turret type tuner, in which an entire unused channel strip can be removed and replaced with a new strip designed for use at the local channel frequencies. The system used by Standard Coil Products Company to make its tuners receptive to UHF is the method shown in the block diagram (Figure 3b). Notice that there are no new stages which require tubes, so that the same tuner circuit may be used. Additional mixing is obtained with a small rectifier built into the base in the inserted strip.

A new idea is now involved, however. Two oscillators are needed for double conversion in this system, and two output frequencies are used from the single oscillator stage to simulate the two oscillators. The fundamental frequency of the oscillator will provide the second frequency conversion, and some harmonic of this frequency is used to beat with the incoming UHF signal in the first conversion. Orders of harmonics range up to the seventh or eighth in some cases, but will vary with the individual channel involved.

The facts concerning this type of tuner indicate that the frequency setting of the fundamental of the local oscillator is extremely critical and important for best reception. The input capacity of the circuit into which the strip is connected will reflect some variation in the tuning of its oscillator, and this variation is multiplied by the order of harmonics used for the first conversion to provide a rapid shift away from the expected first i-f center frequency.

The second conversion may push the resulting center frequency even further away from the expected regular i-f center. This will result in a detuned effect which may be difficult or impossible to correct by variation of the fine tuning control. Since this fine tuning control needs some reserve tunability to compensate for aging characteristics of the parts, the proper step is to touch up the frequency tuned by the local oscillator with the fine tuning control set at its center point.

Information as to the frequency assignment for local oscillator fundamentals is not yet available in general, but may be obtained for individual channels. To request this information from the manufacturer, indicate the channel number, the model designation of the tuner manufacturer's series in use in the particular receiver, and as a precaution, the receiver

manufacturer's receiver or chassis number. Then you will find that the fundamental frequency of the oscillator lies within a frequency range which may be tuned with the A-M generator section of the Simpson Model 479 or 480. Set up this frequency with the aid of the crystal check points and the logging scale of the generator, and zero beat the local oscillator of the UHF strip against the output of the A-M generator.

Follow up this oscillator setting with an analytical response waveform, using the frequency settings recommended in the tables beginning on page 14.

The third basic system, shown in figure 3c, is similar to the block daigram of the familiar VHF receiver circuit. It provides only one conversion of the frequency from the incoming UHF signal to the regular local i-f. The oscillator may operate on either a fundamental or a harmonic, and this will vary from one manufacturer of receivers to another. This condition may apply to some brands of strip tuners other than Standard Coil Products, and definitely does apply to the case where a manufacturer has included a continuous tuner for all channels in his receiver.

In the associated circuits, there is usually a separate oscillator stage and a tuning circuit to be used in UHF reception, and the VHF oscillator is disabled and either or both the r-f amplifier stage of the VHF tuner and the oscillator are transferred into additional stages of intermediate frequency amplification. This means that the alignment of the i-f system must include the tuning of these added stages when the receiver is set for UHF over the alignment of the several basic stages of amplification used for i-f when the same receiver is set for VHF reception. The same problems of tracking exist in this type of receiver arrangement as were pointed out in the discussion of converters-plus-VHF receivers several paragraphs above.

Summing up these circuit descriptions and their individual requirements, it is obvious that no matter which system is used for reception, there are several points which all will have in common. First, the same i-f amplifier circuit and frequencies will be in use for UHF as for VHF. In the case of single conversion

receivers, there may be added stages, but the basic response characteristics have to remain the same. Second, there is some adjustment or pretesting which should be done on each unit combination. And third, some reliable source is necessary to provide a signal, with markers if possible, at the UHF incoming frequencies.

APPLYING THE SIMPSON GENERATOR

The first step in aligning any UHF receiver is to establish the correct response from its intermediate frequency amplifier and its sound discriminator. The steps here are identical to those required for i-f response adjustments for proper VHF reception. The frequencies lie either in a general area around 25 megacycles, or else in an area around 45 megacycles, depending on the brand of the receiver. In either case, the normal procedure for using the Signal Generator is the same, and the frequencies are the same, as in the alignment of this section for VHF reception. Set up the F-M Generator section of the Simpson Model 479 or 480 to produce the intermediate frequency of the receiver. Set the F-M Sweep control to sweep this center frequency through a 15 megacycle range. Apply this signal from the output cable to the signal input point recommended by the receiver manufacturer. Apply battery bias to replace AGC if the manufacturer recommends it for i-f alignment.

Connect the signal return cable across the output of the video detector and return the response waveform to the generator to be used for vertical deflection on the associated oscilloscope. Then use the A-M Generator to identify specific frequencies within the range represented in the output of the F-M Generator. Adjust the component parts of the i-f system to produce an acceptable waveform. This is identified in the receiver manufacturer's literature together with detailed information concerning what adjustments are necessary and how to find them.

In cases of severe maladjustment, this complete waveform analysis is not practical until each adjustment has been brought into an approximately correct position. In these extreme cases, turn off the F-M Generator, and tune the A-M Generator for one critical frequency and adjust the indicated component of the i-f system for a

maximum or minimum response according to the voltage read on a vacuum tube voltmeter or a high impedance voltmeter across the output of the video detector. Then change the frequency of the A-M Generator to another critical frequency, and adjust the component which most affects receptability of that frequency for a maximum or minimum, whichever it should be. When all the critical frequencies have been used for these individual readings and adjustments, the rough tuning of the i-f system is complete, and the final adjustments can now be made by the waveform method.

The next step will depend on the system of UHF reception. If the converter-plus-VHF receiver system is used, the R-F tuner circuits in the VHF receiver must be aligned for the channel which will be used for receiving the output from the converter. This is usually channel 5 or 6, but some brands of converters have outputs at other VHF channel frequencies. In any event, some channel must be selected as the one which will be used for UHF reception for that particular combination of units. When it has been determined, the alignment of component parts of the tuner for the chosen channel must be accomplished with as much care as possible.

The manufacturer's instructions will give details as to where to feed in the signal and where to take it out, what frequency range to tune with the signal generator, what frequencies to mark, what adjustments to make, and any other instructions necessary to accomplish satisfactory i-f adjustment of his receiver. Follow his instructions.

After the i-f, R-F, and sound circuits are aligned, you are assured of the best reproduction of any proper signal which will enter the antenna terminals. All the adjustments which have been made up to this point are in the VHF receiver, and are made within the normal functioning range of the Simpson Signal Generator. This is the most practical servicing equipment which you could use for VHF alignment, and best UHF reception will depend on the basic alignment of these circuits for proper amplification and reproduction.

The final step in aligning the UHF converter-plus-VHF receiver system is to apply the frequencies of the

desired UHF channel to the antenna terminals of the converter, and to connect the converter output to the antenna input terminals of the VHF receiver. Use as short a piece of antenna lead as is physically practical to connect the converter to the receiver. Connect the output cable of the Signal Generator to the UHF converter's antenna input terminals and the signal return cable across the output of the video detector.

Consult the table of frequency settings, beginning on page 14, and tune the F-M Generator and A-M Generator to the recommended fundamental frequencies for the channel which you want to tune. These recommended fundamentals will produce harmonics which are the frequencies needed for the channel. Then tune the converter to the approximate setting to receive the desired channel.

When the overall response waveform appears on the oscilloscope, tune the converter to a point where the video and sound markers appear at their correct positions on the overall response pattern, and the entire system is tuned to receive the UHF signal. Use as little output from the Signal Generator and as much gain in the vertical amplifier of the oscilloscope as possible, without noise appearing on the response waveform.

If the manufacturer recommends bias for i-f alignment of the VHF receiver, it is usually a good plan to apply at least a part of this bias voltage during the UHF overall response waveform analysis. On the low channels, it may be possible to obtain enough signal output from the test point of the VHF receiver used to see R-F response only.

Not all manufacturers include such a test point, but alignment of the converter circuits is more definite when these test points can be used and when there is enough signal strength to permit analysis without more amplification. Any variations from the balance in the correct VHF response waveforms, whether tuner response or overall response, are now caused by the UHF converter. So the tuning slugs on the UHF converter should be touched up to provide the best response waveform possible, and the alignment procedure is complete.

There is one possibility of interference from the generator signals. This occurs when the fundamental which must be tuned to produce a UHF tunable harmonic on the F-M Generator falls within the tuning range of

the VHF receiver. Some leakage is bound to get through and produce a response in the waveform as seen on the oscilloscope. When this occurs, tune the generator which is producing the interference to an alternate fundamental frequency, and use a higher harmonic. These alternate frequencies are indicated in the table with () around them.

The second reception system, based on the use of a single oscillator producing two conversions of frequency requires the following steps after alignment of the i-f strip and sound section of the receiver. Connect the output cable of the signal generator across the antenna terminals of the receiver, and the signal return lead across the output of the video detector.

Observe the overall waveform response and mark the video and sound carrier frequencies. If, with the aid of the fine tuning control on the tuning shaft, the correct waveform can be obtained with the video and sound carrier frequencies properly placed on the waveform, all that the unit requires for use is a touch-up of the oscillator tuning. To do this, set the fine tuning control at the center of its range and remove the tuning knobs. Then reach inside the tuner with an insulated screwdriver and retune the oscillator tuning slug CAREFULLY to place the waveform at its proper position with the aid of markers for video and sound carrier frequencies. Then replace the tuning knobs and the receiver is ready for use.

However, if the response waveform occurs at a frequency further removed from the required UHF channel frequency than can be brought in with the aid of the fine tuning control, the actual fundamental frequency of the oscillator must be adjusted. This can occur when abnormal amounts of input capacity exist in the oscillator stage of the individual tuner, and will be caused by only slight movements of the component parts of the oscillator circuit or by aging of its parts. Whatever the cause may be, the oscillator must be made to operate at the precise fundamental frequency assigned to that particular strip.

The recommended method is to set the A-M generator tuning at the assigned frequency and mix the output of this generator with the output of the local oscillator in the tuner. The easiest way to do this is to connect

the output cable of the generator at the antenna terminals of the receiver and the signal return cable at the looker point of the tuner. Enough of the signal generator output can be made to feed through the first mixer, and then through the first i-f stage to beat with the fundamental of the oscillator in the second mixer to produce a good zero beat indication. Then adjust the oscillator tuning slug CAREFULLY for a zero beat against the frequency established by the A-M Generator.

Turn the F-M generator off during this procedure, and set the desired frequency exactly with the crystal check points and logging scale of the A-M generator. Then return to the overall waveform response outlined above for final touch-up adjustments.

Any out-of-balance conditions which exist in the overall response waveform are due to tuning of the first mixer, first i-f amplifier, or second mixer. The manufacturer of the strips recommends that no attempt be made to correct the tuning of these stages, but you can be the best judge of whether or not you care to risk touching these up for better response characteristics. You could destroy the usability of the strip, but that would be a small price to pay for the experience you would gain.

There is one more possibility in adjusting this strip which may be of some value. Connect the output of the Model 479 or 480 at the antenna terminals, and set the F-M generator at the center frequency of the first i-f stage. Connect the signal return across the video detector output for an overall type of response waveform. However, the frequencies at which the video and sound carrier frequencies will exist must be calculated, and this is the specific drawback to the use of this extra possibility.

The third type of system for UHF reception is the single conversion, with either strips or continuous tuning. The basic ideas outlined for overall waveform response following alignment of the i-f and sound circuits of the receiver are used in the same manner for this system of reception as for the converter-plus-VHF receiver system. In this system, obviously, there is no VHF tuner response to be adjusted.

After i-f and sound adjustments are complete, set the F-M generator to the recommended center frequency for the channel to be received, and tune the receiver for an overall waveform response at that channel. Then set the A-M generator according to the instructions in the table, and mark the video and sound carrier frequencies, if possible.

In the case where single channel strip tuners are used for single conversion types of receivers, the local oscillator will usually use a harmonic to mix with the incoming UHF signal and produce the intermediate frequency of the receiver. If the fundamental frequency of this oscillator is known, it can be adjusted by the zero beat method outlined for double conversion with strip tuners outlined above. Otherwise, the general conditions for overall response analysis prevail here as in the other cases.

Summing up the conditions of usability of the Simpson Model 479 TV and FM Signal Generator, or the Simpson Model 480 Genescope, the first job to be done in alignment of any type of UHF receiver system is to correct all the adjustments in the i-f strip of the receiver. That is one job for which the generators were specifically designed, and they are recommended for use in these adjustments by all the major receiver manufacturers' service departments and service managers. There are

There are signals available from the outputs to the F-M and A-M signal generator sections to complete the UHF tuning in most channels. This is on the basis that the output of the F-M generator, on its B range, has strong enough harmonic signal strength to use the second, third, and fourth harmonics of the frequencies tuned as a signal input for overall response waveform analysis and beyond channel 83, and the output of the harmonics of the A-M generator may be used up through the seventh harmonic to produce markers on the response waveform through most of the UHF range. These harmonics carry the basic accuracy of the fundamental, which is 0.1%. In other words, any harmonic frequency established by proper tuning of the A-M generator is within 0.1% of the desired frequency, and this is sufficiently accurate for alignment and adjustment.

Table I. Step-by-step Procedures for UHF Alignment.

A. Converter-plus-VHF receiver systems.

1. Align the i-f and sound stages of the receiver as for VHF reception. Use the receiver manufacturer's instructions.

2. Align the R-F tuner of the VHF receiver for the channel to be used for UHF reception.

3. Connect the UHF converter ahead of the VHF receiver and observe an overall type of response to a harmonic signal from the F-M Generator, marked with the harmonics of the A-M Generator.

B. Double conversion system, using a UHF strip in an unused channel of the turret tuner in a VHF receiver.

1. Align the i-f and sound stages of the receiver as for VHF reception. Use the receiver Manufacturer's instructions.

2. Observe an overall response to a harmonic signal from the F-M Generator, marked with the harmonics of the A-M Generator.

3. If the oscillator is severely misaligned, zero beat its fundamental against the output of the A-M Generator to tune it.

C. Single conversion system, using either strip or continuous tuning.

1. Align the i-f and sound stages of the receiver as for VHF reception. Use the receiver manufacturer's instructions.

2. Observe an overall response to a harmonic signal from the F-M Generator, marked with the harmonics of the A-M Generator.

USING THE MARKER GENERATOR

The instruction book which is included with each Model 479 or 480 shows in detail how to tune any desired frequency within the range of the instrument within 0.1%. This procedure, using the crystal check points and the logging scale, should be followed closely in order to set the exact frequencies whose fundamentals will produce harmonics at the frequencies required to mark the video and sound carrier points of the overall response waveforms. As the order of harmonics in use becomes gradually higher, the signal strength of the harmonic frequency becomes gradually lower. That is why the highest frequencies (in the highest channels) can rarely be marked. However, there are several circuit variations in the output cable termination box which sometimes improve the possibilities of marking the highest frequencies in the UHF spectrum.

Normally this output box is connected for a 300 ohm termination and left that way. The series capacitor can be shorted, an isolation pad can be connected in the box, and the connections can be changed to 'Open Termination'. Try some of these alternate connections available at the output termination box. Each of them has provided some extension of the range of frequencies which can be marked with various receiver combinations.

In the laboratory, we have actually accomplished marking channel 83 video and sound carrier points in two different combinations of equipment. In both of these cases, the marking was accomplished with the output cable termination box connected for 'Open Termination' with the series condenser shorted out. In general, however, usable markers are obtained with standard equipment and terminations up through about 800 megacycles.

Since this continuous range of markers is available through channel 68, and this range includes almost all the present channel allotments which have been made to this time, the usability of the marker generator can generally be called satisfactory for UHF use.

FREQUENCY SETTINGS

The following table of frequency settings for both generators indicates; 1, the channel number; 2, the

actual frequency required for that channel; 3, the fundamental frequency setting of the generator which will have a harmonic at the desired frequency; and 4, the order of harmonic of the generator which will produce the desired frequency. The first three columns are self explanatory. The fourth column is included to provide reference information to you which will guide you to proper settings of the F-M Sweep control on the generator, and help you interpret the signal strength of the harmonic frequency which causes the response or marker. Remember that harmonics of the F-M generator will be swept through greater ranges of frequency than will the fundamental. If you wish to spread out the response waveform on the trace, the sweep control must be reduced to a lower setting for each successive higher order of harmonics which is being used.

Table II.
F-M GENERATOR TUNING

CHANNEL	CENTER FREQUENCY (MC.)	FUNDAMENTAL CENTER FREQ.	HARMONIC
14	474	237	2
15	480	240	2
16	486	243	2
17	492	246	2
18	498	249	2
19	504	252	2
20	510	255	2
21	516	258	2
22	522	174 (104.4)	3 (5)
23	528	176 (105.6)	3 (5)
24	534	178 (106.8)	3 (5)
25	540	180 (108)	3 (5)
26	546	182 (109.2)	3 (5)
27	552	184 (110.4)	3 (5)
28	558	186 (111.6)	3 (5)
29	564	188 (141)	3 (4)
30	570	190 (142.5)	3 (4)
31	576	192 (144)	3 (4)
32	582	194 (145.5)	3 (4)
33	588	196 (147)	3 (4)
34	594	198 (148.5)	3 (4)


Max Schinke
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Edward Morgan
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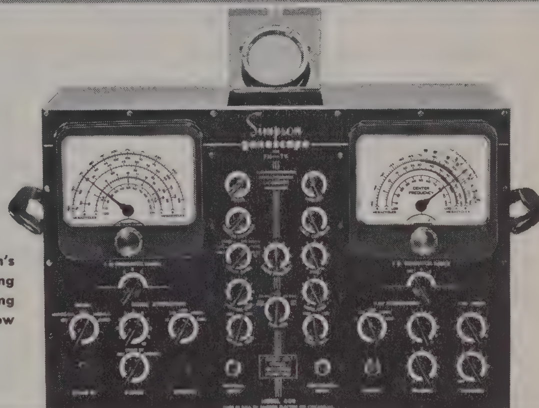
Harold Schulman
DUMONT
Art Richards
Arvin
Field Strength Meter
2. Model 303
Vacuum Tube Volt-Ohmmeter
3. Model 260
4. Model 485
Synchronized Crosshatch
Pattern Generator
5. Model 276
Oscilloscope Calibrator
Model 476
7. Model 479
TV-FM Signal Generator

1 2 3 4

FOR UHF



Just by using a new technique, Simpson's famous 480 masters the problem of checking UHF signals. Long the standard for testing the alignment of VHF signals, the 480 now serves you doubly.

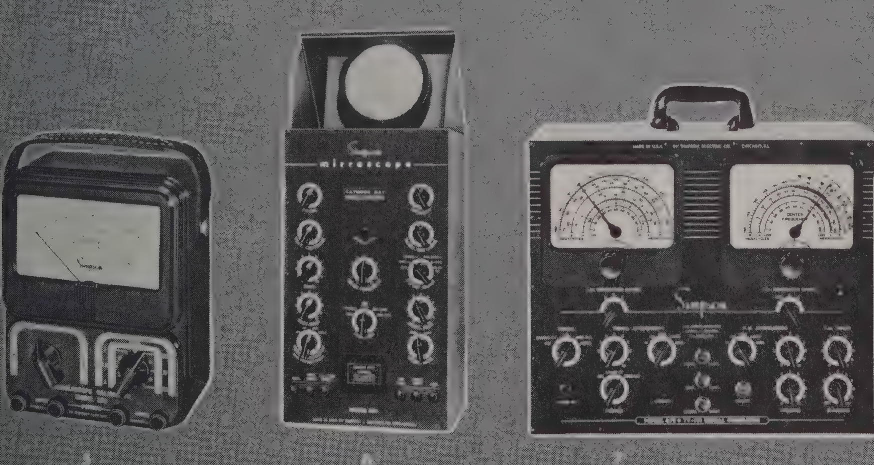


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Table II. (Continued)
F-M GENERATOR TUNING

CHANNEL	CENTER FREQUENCY (MC.)	FUNDAMENTAL CENTER FREQ.	HARMONIC
35	600	200 (150)	3
36	606	202 (151.5)	3
37	612	204 (153)	3
38	618	206 (154.5)	3
39	624	208 (155)	3
40	630	210 (157.5)	3
41	636	212 (159)	3
42	642	214 (160.5)	3
43	648	216 (162)	3
44	654	218	3
45	660	220	3
46	666	222	3
47	672	224	3
48	678	226	3
49	684	228	3
50	690	230	3
51	696	232	3
52	702	234	3
53	708	236	3
54	714	238	3
55	720	240	3
56	726	242	3
57	732	244	3
58	738	246	3
59	744	248	3
60	750	250	3
61	756	252	3
62	762	254	3
63	768	256	3
64	774	258	3
65	780	260	3
66	786	196.5 (157.2)	4 (5)
67	792	198 (158.4)	4 (5)
68	798	199.5 (159.6)	4 (5)
69	804	201 (160.8)	4 (5)
70	810	202.5 (162)	4 (5)
71	816	204 (163.2)	4 (5)
72	822	205.5 (164.4)	4 (5)
73	828	207 (165.6)	4 (5)

Table II. (Continued)
FF-M GENERATOR TUNING

CHANNEL	CENTER FREQUENCY (MC.)	FUNDAMENTAL CENTER FREQ.	HARMONIC
74	834	208.5 (166.8)	4 (5)
75	840	210 (168)	4 (5)
76	846	211.5 (169.2)	4 (5)
77	852	213 (170.4)	4 (5)
78	858	214.5 (171.6)	4 (5)
79	864	216 (172.8)	4 (5)
80	870	217.5	4
81	876	219	4
82	882	220.5	4
83	888	222	4

NOTE: All frequencies appearing in parentheses () in the above table are alternate frequency settings which may be used when a converter-plus-VHF receiver type of reception uses a VHF tuner channel tuned near the fundamental frequency in the first recommended setting. The harmonic order of each of these alternate frequencies is also in parentheses ().

TABLE III.
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
14	LOWER LIMIT	470	117.50	4
	VIDEO CARR.	471.25	117.81	4
	SOUND CARR.	475.75	118.94	4
	UPPER LIMIT	476	119.00	4
15	L L	476	119.00	4
	V C	477.25	119.31	4
	S C	481.75	120.44	4
	U L	482	120.50	4
16	L L	482	120.50	4
	V C	483.25	120.81	4
	S C	487.75	121.94	4
	U L	488	122.00	4

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
17	LOWER LIMIT	488	122.00	4
	VIDEO CARR.	489.25	122.31	4
	SOUND CARR.	493.75	123.44	4
	UPPER LIMIT	494	123.50	4
18	L L	494	123.50	4
	V C	495.25	123.81	4
	S C	499.75	124.94	4
	U L	500	125.00	4
19	L L	500	100.00	5
	V C	501.25	100.25	5
	S C	505.75	101.15	5
	U L	506	101.20	5
20	L L	506	101.20	5
	V C	507.25	101.45	5
	S C	511.75	102.35	5
	U L	512	102.40	5
21	L L	512	102.40	5
	V C	513.25	102.65	5
	S C	517.75	103.55	5
	U L	518	103.60	5
22	L L	518	103.60	5
	V C	519.25	103.85	5
	S C	523.75	104.75	5
	U L	524	104.80	5
23	L L	524	104.80	5
	V C	525.25	105.05	5
	S C	529.75	105.95	5
	U L	530	106.00	5
24	L L	530	106.00	5
	V C	531.25	106.25	5
	S C	535.75	107.15	5
	U L	536	107.20	5

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
25	LOWER LIMIT	536	107.20	5
	VIDEO CARR.	537.25	107.45	5
	SOUND CARR.	541.75	108.35	5
	UPPER LIMIT	542	108.40	5
26	L L	542	108.40	5
	V C	543.25	108.65	5
	S C	547.75	109.55	5
	U L	548	109.60	5
27	L L	548	109.60	5
	V C	549.25	109.85	5
	S C	553.75	110.75	5
	U L	554	110.80	5
28	L L	554	110.80	5
	V C	555.25	111.05	5
	S C	559.75	111.95	5
	U L	560	112.00	5
29	L L	560	112.00	5
	V C	561.25	112.25	5
	S C	565.75	113.15	5
	U L	566	113.20	5
30	L L	566	113.20	5
	V C	567.25	113.45	5
	S C	571.75	114.35	5
	U L	572	114.40	5
31	L L	572	114.40	5
	V C	573.25	114.65	5
	S C	577.75	115.55	5
	U L	578	115.60	5
32	L L	578	115.60	5
	V C	579.25	115.85	5
	S C	583.75	116.75	5
	U L	584	116.80	5

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
33	LOWER LIMIT	584	116.80	5
	VIDEO CARR.	585.25	117.05	5
	SOUND CARR.	589.75	117.95	5
	UPPER LIMIT	590	118.00	5
34	L L	590	118.00	5
	V C	591.25	118.25	5
	S C	595.75	119.15	5
	U L	596	119.20	5
35	L L	596	119.20	5
	V C	597.25	119.45	5
	S C	601.75	120.35	5
	U L	602	120.40	5
36	L L	602	120.40	5
	V C	603.25	120.65	5
	S C	607.75	121.55	5
	U L	608	121.60	5
37	L L	608	121.60	5
	V C	609.25	121.85	5
	S C	613.75	122.75	5
	U L	614	122.80	5
38	L L	614	122.80	5
	V C	615.25	123.05	5
	S C	619.75	123.95	5
	U L	620	124.00	5
39	L L	620	103.33	6
	V C	621.25	103.54	6
	S C	625.75	104.29	6
	U L	626	104.33	6
40	L L	626	104.33	6
	V C	627.25	104.54	6
	S C	631.75	105.29	6
	U L	632	105.33	6

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
41	LOWER LIMIT	632	105.33	6
	VIDEO CARR.	633.25	105.54	6
	SOUND CARR.	637.75	106.29	6
	UPPER LIMIT	638	106.33	6
42	L L	638	106.33	6
	V C	639.25	106,54	6
	S C	643.75	107.29	6
	U L	644	107.33	6
43	L L	644	107.33	6
	V C	645.25	107.54	6
	S C	649.75	108.29	6
	U L	650	108.33	6
44	L L	650	108.33	6
	V C	651.25	108.54	6
	S C	655.75	109.29	6
	U L	656	109.33	6
45	L L	656	109.33	6
	V C	657.25	109.54	6
	S C	661.75	110.29	6
	U L	662	110.33	6
46	L L	662	110.33	6
	V C	663,25	110.54	6
	S C	667.75	111.29	6
	U L	668	111.33	6
47	L L	668	111.33	6
	V C	669.25	111.54	6
	S C	673.75	112.29	6
	U L	674	112.33	6
48	L L	674	112.33	6
	V C	675.25	112.54	6
	S C	679.75	113.29	6
	U L	680	113.33	6

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
49	LOWER LIMIT	680	113.33	6
	VIDEO CARR.	681.25	113.54	6
	SOUND CARR.	685.75	114.29	6
	UPPER LIMIT	686	114.33	6
50	L L	686	114.33	6
	V C	687.25	114.54	6
	S C	691.75	115.29	6
	U L	692	115.33	6
51	L L	692	115.33	6
	V C	693.25	115.54	6
	S C	697.75	116.29	6
	U L	698	116.33	6
52	L L	698	116.33	6
	V C	699.25	116.54	6
	S C	703.75	117.29	6
	U L	704	117.33	6
53	L L	704	117.33	6
	V C	705.25	117.54	6
	S C	709.75	118.29	6
	U L	710	118.33	6
54	L L	710	118.33	6
	V C	711.25	118.54	6
	S C	715.75	119.29	6
	U L	716	119.33	6
55	L L	716	119.33	6
	V C	717.25	119.54	6
	S C	721.75	120.29	6
	U L	722	120.33	6
56	L L	722	120.33	6
	V C	723.25	120.54	6
	S C	727.75	121.29	6
	U L	728	121.33	6

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
57	LOWER LIMIT	728	121.33	6
	VIDEO CARR.	729.25	121.54	6
	SOUND CARR.	733.75	122.29	6
	UPPER LIMIT	734	122.33	6
58	L L	734	122.33	6
	V C	735.25	122.54	6
	S C	739.75	123.29	6
	U L	740	123.33	6
59	L L	740	123.33	6
	V C	741.25	123.54	6
	S C	745.75	124.29	6
	U L	746	124.33	6
60	L L	746	106.57	7
	V C	747.25	106.75	7
	S C	751.75	107.39	7
	U L	752	107.43	7
61	L L	752	107.43	7
	V C	753.25	107.61	7
	S C	757.75	108.25	7
	U L	758	108.29	7
62	L L	758	108.29	7
	V C	759.25	108.46	7
	S C	763.75	109.11	7
	U L	764	109.14	7
63	L L	764	109.14	7
	V C	765.25	109.32	7
	S C	769.75	109.96	7
	U L	770	110.00	7
64	L L	770	110.00	7
	V C	771.25	110.18	7
	S C	775.75	110.82	7
	U L	776	110.86	7

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
65	LOWER LIMIT	776	110.86	7
	VIDEO CARR.	777.25	111.04	7
	SOUND CARR.	781.75	111.68	7
	UPPER LIMIT	782	111.71	7
66	L L	782	111.71	7
	V C	783.25	111.89	7
	S C	787.75	112.54	7
	U L	788	112.57	7
67	L L	788	112.57	7
	V C	789.25	112.75	7
	S C	793.75	113.39	7
	U L	794	113.43	7
68	L C	794	113.43	7
	V C	795.25	113.61	7
	S C	799.75	114.25	7
	U C	800	114.29	7
69	L L	800	114.29	7
	V C	801.25	114.46	7
	S C	805.75	115.11	7
	U L	806	115.14	7
70	L L	806	115.14	7
	V C	807.25	115.32	7
	S C	811.75	115.96	7
	U L	812	116.00	7
71	L L	812	116.00	7
	V C	813.25	116.18	7
	S C	817.75	116.82	7
	U L	818	116.86	7
72	L L	818	116.86	7
	V C	819.25	117.04	7
	S C	823.75	117.68	7
	U L	824	117.71	7

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
73	LOWER LIMIT	824	117.71	7
	VIDEO CARR.	825.25	117.89	7
	SOUND CARR.	829.75	118.54	7
	UPPER LIMIT	830	118.57	7
74	L L	830	118.57	7
	V C	831.25	118.75	7
	S C	835.75	119.39	7
	U L	836	119.43	7
75	L L	836	119.43	7
	V C	837.25	119.61	7
	S C	841.75	120.25	7
	U L	842	120.29	7
76	L L	842	120.29	7
	V C	843.25	120.46	7
	S C	847.75	121.11	7
	U L	848	121.14	7
77	L L	848	121.14	7
	V C	849.25	121.32	7
	S C	853.75	121.96	7
	U L	854	122.00	7
78	L L	854	122.00	7
	V C	855.25	122.18	7
	S C	859.75	122.82	7
	U L	860	122.86	7
79	L L	860	122.86	7
	V C	861.25	123.04	7
	S C	865.75	123.68	7
	U L	866	123.71	7
80	L L	866	123.71	7
	V C	867.25	123.89	7
	S C	871.75	124.54	7
	U L	872	124.57	7

Table III. (Continued)
A-M GENERATOR TUNING FOR MARKERS

CHANNEL		FREQUENCY (MC.)	A-M FUNDAMENTAL FREQ.	HARMONIC
81	LOWER LIMIT	872	109.00	8
	VIDEO CARR.	873.25	109.16	8
	SOUND CARR.	877.75	109.72	8
	UPPER LIMIT	878	109.75	8
82	L L	878	109.75	8
	V C	879.25	109.91	8
	S C	883.75	110.47	8
	U L	884	110.50	8
83	L L	884	110.50	8
	V C	885.25	110.66	8
	S C	889.75	111.22	8
	U L	890	111.25	8

Note: the frequencies in the preceding table include recommended settings for all channels through #83. Each frequency listed is the highest fundamental tunable with the A-M Generator unit in the Simpson Model 479 or 480 which will produce the necessary UHF frequency as one of it's harmonics. Theoretically, these should be the best possible tuning points to produce a marker on the response waveform, but it may be possible to locate another point on the dial which has a higher order harmonic at the desired frequency, but may produce a better marker in your generator. To locate alternate fundamental frequency settings, divide the desired frequency by the next higher number than is shown under the heading 'Harmonic' in table III, and try to use the new calculated fundamental to produce a marker.

For example, suppose that you are establishing a channel 70 response, and the 7th harmonics of the recommended fundamentals, 115.32 and 115.96 Mc., will not produce a marker on the response curve for the video carrier and the sound carrier points. After trying out the various possible connections of the output cable termination box as suggested on page 13, divide the desired frequencies, 807.25 and 811.75 Mc., by 8. This will indicate that the eighth harmonics of

these frequencies can be tuned when the fundamentals are 100.61 and 101.47 Mc. respectively. It is possible in some generators for the eighth harmonics of these frequencies to have more signal strength than the seventh harmonic of the recommended fundamentals, and marking may be more successful by using them.

DISTINGUISHING TRUE AND FALSE MARKERS

Due to the fact that there are several oscillators operating within a small physical area, it is possible to get a variety of markers which are not related to the tuned generators, and have to be disregarded. There is a three step method which will definitely distinguish a true marker from any of the false ones which appear at uncalculated points during the tuning procedure.

A true marker will pass the conditions imposed by all three of these steps, while a false marker will fail at least one of the steps. If a marker passes all three conditions, the resulting marker on the trace measures the exact point where a harmonic of the fundamental tuned on the A-M generator exists on the response waveform. Knowing the approximate setting of the UHF tuning circuit, the choice between the various possible frequencies which may be marked at that fundamental tuning point is simple, because one of the several possible harmonics will be close to the channel frequency, and the others will be separated much further from it.

The three steps are as follows:

1. Tune the A-M Generator around its tuning point and watch the marker on the response waveform. It should move on the response waveform.
2. Tune the F-M Generator around its tuning point and watch the response waveform and the marker. These should move together on the trace, and the marker should stay at the same relative response point on the waveform as it moves on the trace.
3. Tune the UHF tuning control or the fine tuning control of the VHF receiver. The wavefrom should move on the trace, but the marker should <u>not</u> move to the right or to the left. (It may move up or down to mark different relative response points on the waveform, but must not have any horizontal movement.)

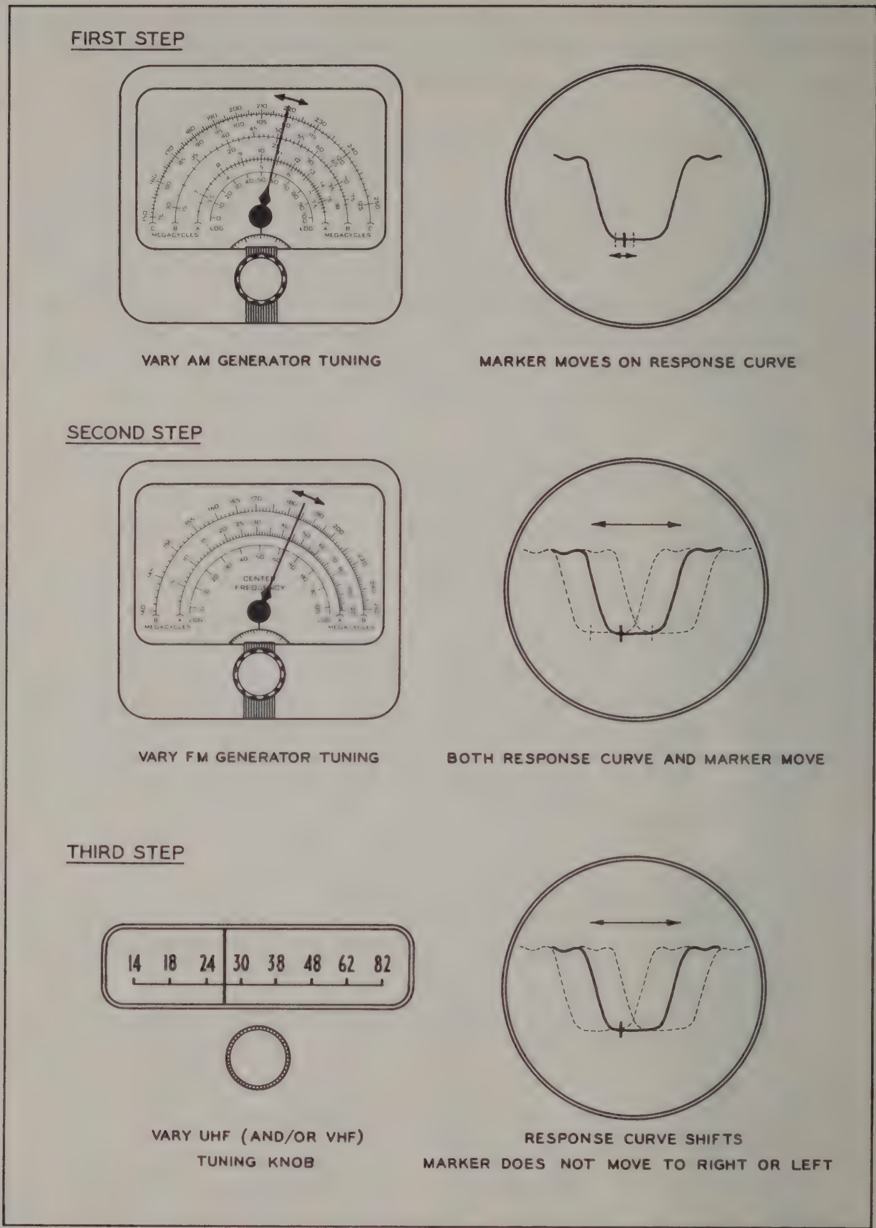
FIRST STEP
VARY AM GENERATOR TUNING
MARKER MOVES ON RESPONSE CURVE
SECOND STEP
VARY FM GENERATOR TUNING
BOTH RESPONSE CURVE AND MARKER MOVE
THIRD STEP
14 18 24 30 38 48 62 82
VARY UHF (AND/OR VHF) TUNING KNOB
RESPONSE CURVE SHIFTS
MARKER DOES NOT MOVE TO RIGHT OR LEFT

Figure - 4.

Figure 4 shows this three step method in a cause-and-effect relationship. When the indicated control is moved, the results on the oscilloscope will be as shown at the right. Do not assume that any marker is a correct one until it has passed the three steps. This will eliminate the costly results of poor workmanship. These undesirable false markers are not characteristic of Simpson Generators, but rather of UHF tuning problems.

Minimum attenuator settings which will produce satisfactory results are recommended for both sections of the Simpson Signal Generators. A minimum signal and maximum amplification in the oscilloscope produce the best results. However, the positions of these attenuator controls for a minimum signal, or for a maximum signal, are not always at the expected lowest or highest physical control positions. Sometimes, an increase in the position of either continuous attenuator control will result in a decrease of the signal strength.

Experiment with these controls when you have established a response which can be seen, and watch the effect on the waveform. At the highest frequencies, the attenuator controls seem to have little or no effect on the output strength. These peculiarities are probably caused by these higher frequencies passing through the small capacities of the attenuator circuits, without having to pass through their intended resistive control paths.

Whatever the cause may be, there is sufficient signal strength in the output to allow the results outlined in the text, and there is a low enough signal strength to prevent overloading the receiver in most cases. However, poor regulation of the output strength at the high end of the UHF tuning range is normal. If any signal strength is sufficient to produce overloading, a bias in the receiver will eliminate the effect so that true response waveforms can be seen.

After the waveform analysis has shown that the combination of components in the UHF tuning system has been tuned for theoretically the best reception at the local station channel frequency, connect an antenna and recheck the results with the signal from the station and a proper antenna system. This practical

application may show that even the small percentage of error possible in the frequency settings of the A-M Generator is responsible for a slight mistuning of the station frequency. If this is true, a slight adjustment of the fine tuning control of the receiver, or of the UHF tuning knob (in a continuous tuning type), will correctly tune the station. Your alignment has been performed with the best commercial equipment on the market today, and you should be able to anticipate good results in your UHF alignment after you have had the benefits which only experience can bring to you.

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